

A First Approach to Introduce Graphical Elements to Improve the Description of Commodity Classes in eCl@ss

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1. Introduction

The description of commodities in classification systems like eCl@ss today is based upon property sets for commodity classes that are more or less developed as mentioned in papers ‘Communications of the Scientific Advisory Board of eCl@ss No. 1¹ and No. 2²’. This paper analyses how graphical elements can contribute to the description of commodities. Furthermore we are interested in the contribution of graphical elements to the development and harmonisation of various language versions in eCl@ss.

In this first approach we focus on a very few classes in order to check how graphical elements can be selected, developed and applied.

We check test classes for different kinds of screws for example. Screws are well standardised e.g. according to ISO, DIN, or ANSI and the documents of standardisation bodies include graphical elements. We compare the attributes of selected screws in the documents of the standardisation bodies with the property lists of such screws in eCl@ss. We identify common attributes and missing attributes on both sides. We can see how the graphical elements can support the application of the property sets.

This first step is limited to very elementary products. In the next step we check products like water taps, shower system installation. In this case there are also well defined standards like:

¹ Reusch, Peter J. A.; Garcia Moreno, Laura Esmeralda: “On Entropies in the Classification of Commodities - a Challenge for E-Commerce”, Communication of the Scientific Advisory Board of eCl@ss No 1, (December 2008).

² Reusch, Peter J. A.; Garcia Moreno, Laura Esmeralda: “Harmonisation of classes and property sets in critical commodity classes of eCl@ss”, Communication of the Scientific Advisory Board of eCl@ss No 2, (March 2009).

- DIN 7572*, focused on the diameter and pillar tap dimensions of water fittings for sanitary installations.
- DIN 7577*, concentrated on the dimensions for simple taps for mounting on vertical surfaces.
- DIN 7578*, focused on mixing taps with combined visible body known as 'single hole' for mounting on horizontal surfaces, dimensions.
- DIN 2999, focused on the cylindrical internal and taper external thread, the internal-external diameter of the connecting tubes and the dimensions of the gauges.
- ASME/ANSI A112.18.1M* American standard

*Related to sanitary appliances

In these cases graphical representations for products of such commodity classes are derived from graphical representations in the web catalogues of manufacturers of such products. Various graphical representations of similar products from several manufacturers are compared. Then unified and simplified graphical representations are developed. And again we show how these graphical elements contribute to the description of commodity classes in eCI@ss.

2. Graphical Elements for Elementary Non-composite Commodities

The eCl@ss classification system describes composite and non-composite commodities. A non-composite commodity is an elementary product like for example a screw, which can be part of another complex product (composite commodities) e.g. a sanitary installation system.

This chapter analyses selected non-composite commodity classes related to screws in order to compare their attributes assigned in eCl@ss³ and in other standards like ANSI⁴ (American National Standards), DIN⁵ (Deutsches Institut für Normung – German Institute for Standardisation) and ISO⁶ (International Organisation for Standardisation)⁷. Then we show the missing properties in eCl@ss and describe such properties by graphical representations used in the international standards. Based on this research we propose a complementary set of properties for eCl@ss and the support by standardised graphical representations.

Graphical representations help not only to define the technical elements of the product but also to unify languages to describe those elements. In general a screw consists of a set of basic elements like head, slot, shank, and thread. Fig. 1 shows a general graphical representation for a screw in five languages (German, English, French, Spanish and Italian).

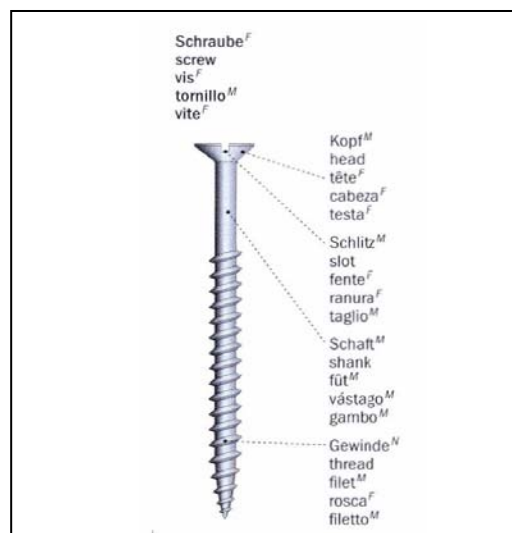


Fig. 1: General graphical representation for a general screw ⁸

³ www.eclass.com / www.eclass.de

⁴ www.ansi.org

⁵ www.din.de

⁶ www.iso.org/iso/home.htm

⁷ More details available in appendix C

⁸ Corbeil, Jean-Claude; Archambault, Ariane: “Bildwörterbuch Deutsch, English, Französisch, Spanisch, Italienisch”. PONS Editorial, (2003), pp.302. ISBN-10: 3-12-517833-9.

Those basic elements become more detailed when a specific screw is required like e.g. wood screws, wing screws, hexagon screw, etc. On the one hand side a detailed description of a product defines specific and unique properties that differentiate it from other products⁹. On the other hand side the more detailed the description of the product is, the more difficult it is to relate the specified property with the product.

In order to facilitate the relation between properties and products it is helpful to harmonise the properties according to standards like DIN, ISO, ANSI, etc. Those standards have a good technical description supported by graphical representations. For example, within the DIN (Deutsches Institut für Normung – German Institute for Standardisation) standard there is not only a well developed set of properties and visual representations for screws, but also there is a way to reduce the language problems by unifying symbols and designations of dimensions in different languages. Such description is introduced with DIN EN ISO 225 as it is shown in chapter 2.3 of this paper.

2.1 Comparison of property sets for selected screws in eCl@ss, ANSI and DIN

In some cases eCl@ss has a well developed set of properties, but the classification system is still dealing with a set of properties that has to be improved. For some products there are essential properties missing.¹⁰ The comparison of property sets between eCl@ss, ANSI and DIN is useful to analyse and to find the gaps in the set of properties in eCl@ss. This chapter analyses three commodity classes related to screw (wood screw, thumb screw and cap screw) in eCl@ss and compares the list of properties with the international standards.

Tab. 1 shows three selected commodity classes related with screw in eCl@ss and similar commodities found in the ANSI and DIN standards.

⁹ Reusch, Peter J. A.; Wolfgang, Wilkes; Garcia Moreno, Laura Esmeralda; Dong, Hui: “On the Application of the New Data Model of eCl@ss”, Communication of the Scientific Advisory Board of eCl@ss No 3, 2nd Edition, (June 2009). pp. 22-26.

¹⁰ Reusch, Peter J. A.; Wolfgang, Wilkes; Garcia Moreno, Laura Esmeralda; Dong, Hui: “On the Application of the New Data Model of eCl@ss”, Communication of the Scientific Advisory Board of eCl@ss No 3, 2nd Edition, (June 2009). pp. 2.

eCl@ss		ANSI		DIN	
Wood screw	23-11-01-11	Flat head (Wood screw)	ANSI-B18.6.1-1981(R2003)	Slotted countersunk (flat) head wood screws	DIN 97
		Oval head (Wood screw)		Slotted raised countersunk (oval) head wood screws	DIN 95
		Pan head (Wood screw)		Slotted round head wood screws	DIN 96
Thumb screw	23-11-06-01	Wing screws Type A and B (Wing nut, wing screws and thumb screws)	ANSI-B18.17-1968(R1983)	Wing screws, rounded wings	DIN 316
Cap screw	23-11-01-19	Hexagon socket head cap screws-Metric series	BS4168:Part1:1981(obsol.)	Hexagon socket head cap screws	DIN EN ISO 4762

Tab. 1: Similar commodity classes related to screw in eCl@ss, ANSI and DIN

In Tab. 1 we can see that there exist detailed commodity classes for ‘Wood screw’ in the ANSI and DIN standards. For those standards the commodity classes are almost identical. In contrast to this approach eCl@ss presents a single commodity for ‘Wood screw’ and it seems that eCl@ss contains a general set of properties for this commodity class, whereas ANSI and DIN use more specific properties. Another observation regarding table 1 is that eCl@ss assigns ‘Wing screw’ to the same commodity class as ‘Thumb screw’. In the ANSI standards, ‘Thumb screws’ and ‘Wing screws’ are two separated commodities but with the same codification (ANSI-B18.17-1968(R1983)¹¹), it means that the ANSI standard has the same set of properties for both commodities.¹²

Tab. 2 shows the property set of eCl@ss categorised into aspects for the selected commodities: wood, cap and thumb screws.

¹¹ Oberg, Erik; Jones, Franklin D.; Horton, Holbrook L.; Ryffel, Henry H.: Machinery’s Handbook 28th Edition, “A reference book for the Mechanical engineer, Designer manufacturing engineer, Draftsman, Toolmaker and Machinist”. Industrial Press Inc, (2008), pp. 1702-1704.

¹² More details available in appendix A

eCI@ss Property category		eCI@ss Property set	Wood screw	Cap screw	Thumb screw
			23-11-01-11	23-11-01-19	23-11-06-01
General Administrative Properties	Basic properties	BAA001003 - Manufacturer name	x	x	x
		BAA002002 - Product type description	x	x	x
		BAA059003 - Supplier product number	x	x	x
		BAD847002 - Manufacturer product number	x	x	x
		BAA316003 - Product name	x	x	x
		BAA271003 - EAN code	x	x	x
		BAA899001 - Order supplement code	x	x	
		BAA900002 - Order supplement accord. to standard	x	x	
		BAB010001 - Publication date (year-month)	x	x	x
		BAB165002 - standard letter to the standard number	x	x	x
		BAB637002 - Product class	x	x	
		BAE162001 - Requirement in accord. with	x	x	x
General Technical Properties		BAA898002 - Drive quantity	x		
		BAA929002 - Product class in accord. with norm	x	x	
		BAA932002 - Key width	x		
		BAA936001 - Tolerance info. in accord. with norm	x	x	x
		BAA997001 - Thread length	x	x	x
		BAB072002 - Tolerance	x	x	x
		BAB101002 - Surface protection	x	x	x
		BAB112001 - Material in accord. with norm	x	x	x
		BAB150001 - Surface protection accord. with norm	x	x	x
		BAB664004 - Material	x	x	x
Special Technical Properties		BAA907001 - Thread diameter	x	x	x
		BAA908002 - Thread direction	x	x	x
		BAA909003 - Thread pitch at nut end	x	x	x
		BAA914001 - Width of screw head	x		
		BAA916001 - Head diameter of screw	x	x	
		BAA917002 - Head form	x		
		BAA918001 - Position of thread coating	x	x	
		BAA919001 - Screw length	x	x	x
		BAA922001 - Length of thread coating	x	x	
		BAA935001 - Width of ligament			x
		BAB090001 - Head form pursuant to standard	x		
		BAB093001 - Head length of screw	x		x
		BAB162001 - Height of head	x	x	x
		BAB618001 - Thread design accord. to standard letter	x	x	x

Tab. 2: Property sets of Wood, Cap and Thumb screw in eCI@ss

Tab. 3 illustrates the comparison of properties between the eCI@ss classification system and the ANSI American National Standard for 3 selected commodity classes (Wood screw, Cap screw and Thumb screw) in eCI@ss. The properties of the ANSI standard were extracted from the information attached in appendix A.

eClass Property set	ANSI Property set	
BAA916001 - Head diameter of screw	Head diameter	Major diameter of screw
BAB162001 - Height of head	Height of head	Nominal size or basic screw diameter
BAA919001 - Screw length	Screw length	Oval point radius
BAA997001 - Thread length	Length of thread	Practical screw length
BAB664004 - Material	Material	Radius or fillet
BAA907001 - Thread diameter	Diameter of thread	Screw Height
BAA932002 - Key width	Key engagement	Series (heavy, light and regular)
BAB072002 - Tolerance*	Body diameter	Series (regular and heavy)
BAA909003 - Thread pitch at nut end*	Body length	Shank permanently inserted into wing portion
BAA908002 - Thread direction*	Boss diameter	Shank welded to wing portion
BAA918001 - Position of thread coating*	Boss height	Shoulder diameter
BAA922001 - Length of thread coating*	Cone point	Style
BAA898002 - Drive quantity	Cup and flat point diameter	Threads per inch
BAA929002 - Product class in accordance with norm	Depth of slot	Total head height
BAA936001 - Tolerance information in accordance with norm	Diameter fillet	Transition thread length
BAB101002 - Surface protection	Diameter tolerance	Wall Thickness
BAB112001 - Material in accordance with norm	Dog point diameter	Width across corners
BAB150001 - Surface protection in accordance with norm	Dog point length	Width across flats
BAA914001 - Width of screw head	Grip ganging length	Width of slot
BAA917002 - Head form	Head blank size (Ref)	Wing height
BAA935001 - Width of ligament	Head radius	Wing spread
BAB090001 - Head form pursuant to standard	Head thickness	Wing thickness
BAB093001 - Head length of screw	Head width	
BAB618001 - Thread design according to standard letter	Hexagon socket size	

* List of technical properties for: Thread of screws (see appendix A-1)

Tab. 3: Comparison of property sets between eCI@ss and ANSI standard for: “Wood screw, Cap screw and Thumb screw”

In Tab. 3 we examine that there are a few sets of similar properties between the eCI@ss and the ANSI standard like e.g. ‘Head diameter’, ‘Height of head’, ‘Screw length’, ‘Length of thread’, etc. (marked in colour). Those properties are basic to a screw group and have to be mandatory for every kind of screws.

Furthermore there exist other similar properties like ‘Tolerance’, ‘Thread diameter’ and ‘Thread pitch at nut end’ (marked with an additional asterisk). Those properties are extracted from the list of properties for ‘Thread screws’ out of the ANSI standard (appendix A-1). The ANSI standard has two independent parts to describe the thread of screws in detail. These parts are mentioned as ‘Metric self-threading screws ANSI/ASME-B18.6.5M-1986’¹³ and ‘Self-threading screws ANSI-B18.6.4-1981(R1991)’¹⁴.

The ANSI standard contains more properties to describe some commodity classes like e.g. ‘Wing screw’¹⁵ than eCl@ss classification system. For ‘Wing screw’ ANSI include specific properties like ‘Wing height’, ‘Wing spread’, ‘Wing thickness’, ‘Oval point radius’, etc. These properties should be considered to be included in the list of properties of eCl@ss.

¹³ Oberg, Erik; Jones, Franklin D.; Horton, Holbrook L.; Ryffel, Henry H.: Machinery’s Handbook 28th Edition, “A reference book for the Mechanical engineer, Designer manufacturing engineer, Draftsman, Toolmaker and Machinist”. Industrial Press Inc, (2008), pp. 1623-1631.

¹⁴ Oberg, Erik; Jones, Franklin D.; Horton, Holbrook L.; Ryffel, Henry H.: Machinery’s Handbook 28th Edition, “A reference book for the Mechanical engineer, Designer manufacturing engineer, Draftsman, Toolmaker and Machinist”. Industrial Press Inc, (2008), pp. 1609-1621.

¹⁵ For more details compare Table 2 and appendix A

Tab. 4 shows the comparison of properties between the eCI@ss classification system and the DIN standard for 3 selected commodity classes (Wood screw, Cap screw and Thumb screw) in eCI@ss. The properties of the DIN standard were extracted from the information of appendix B.

eClass Property set	DIN Property set	
BAA997001 - Thread length	Thread length 'b'	Shank welded to wing portion
BAA907001 - Thread diameter	Basic major diameter (nominal diameter) of thread 'd'	Thickness between driving feature and bearing face 'w'
BAA916001 - Head diameter of screw	Diameter of the head 'dk'	Total depth of intendation of triple square socket 'h'
BAA919001 - Screw length	Nominal length 'l'	Transition length 'lf'
BAB162001 - Height of head	Height of the head 'k'	Width across corners 'e'
BAA898002 - Drive quantity	Boss diameter of head	Width across flats 's'
BAA929002 - Product class in accordance with norm	Boss diameter of length	Width of the slot 'n'
BAA932002 - Key width	Depth of the internal driving feature or slot 't'	Wing diameter of cross recesses 'm'
BAA936001 - Tolerance information in accordance with norm	Diameter of shank	Wing thickness
BAB072002 - Tolerance	Diameter of the unthreaded shank 'ds'	
BAB101002 - Surface protection	Distance from the last full form thread, shank length of bolt 'lg'	
BAB112001 - Material in accordance with norm	Distance from the last full form thread to the bearing face 'a'	
BAB150001 - Surface protection in accordance with norm	Dog point diameter	
BAB664004 - Material	Head thickness	
BAA908002 - Thread direction	Height of the raised (oval) portion of a raised countersunk head 'f'	
BAA909003 - Thread pitch at nut end	Incomplete thread end 'u'	
BAA914001 - Width of screw head	Inner diameter of the bearing face 'da'	
BAA917002 - Head form	Length of the thread run-out 'x'	
BAA918001 - Position of thread coating	Length of unthreaded shank 'ls'	
BAA922001 - Length of thread coating	Outer diameter of the washer face (bearing face) 'dw'	
BAA935001 - Width of ligament	Oval point Radius	
BAB090001 - Head form pursuant to standard	Radius of curvature under head 'r'	
BAB093001 - Head length of screw	Radius of the raised portion of a head 'rf'	
BAB618001 - Thread design according to standard letter	Shank permanently inserted into wing portion	

Tab. 4: Comparison of property sets between eCI@ss and DIN standards for: “Wood screw, Cap screw and Thumb screw”

We can see in Tab. 4 that there are only 5 similar properties between the eCI@ss and DIN standard. DIN uses the same approach as the American standard ANSI. It means that the

DIN¹⁶ and ANSI¹⁷ standards have more specific properties for each commodity class than eCl@ss. In contrast to the eCl@ss classification system both standards have more similar properties in common as it is shown in Tab. 5.

DIN Property set	ANSI Property set	
Dog point diameter	Dog point diameter	Major diameter of screw
Diameter of the head 'dk'	Head diameter	Material
Head thickness	Head thickness	Screw Height
Height of the head 'k'	Height of head	Screw length
Thread length 'b'	Length of thread	Series (heavy, light and regular)
Basic major diameter (nominal diameter) of thread 'd'	Nominal size or basic screw diameter	Series (regular and heavy)
Oval point Radius	Oval point radius	Shoulder diameter
Nominal length 'l'	Practical screw length	Style
Radius of curvature under head 'r'	Radius or fillet	Threads per inch
Shank permanently inserted into wing portion	Shank permanently inserted into wing portion	Total head height
Shank welded to wing portion	Shank welded to wing portion	Wall Thickness
Transition length 'lf'	Transition thread length	Wing height
Width across corners 'e'	Width across corners	Wing spread
Width across flats 's'	Width across flats	
Width of the slot 'n'	Width of slot	
Wing thickness	Wing thickness	
Boss diameter of head	Boss diameter	
Boss diameter of length	Body diameter	
Depth of the internal driving feature or slot 't'	Body length	
Diameter of shank	Boss height	
Diameter of the unthreaded shank 'ds'	Cone point	
Distance from the last full form thread, shank length of bolt 'lg'	Cup and flat point diameter	
Distance from the last full form thread to the bearing face 'a'	Depth of slot	
Height of the raised (oval) portion of a raised countersunk head 'f'	Diameter fillet	
Incomplete thread end 'u'	Diameter of thread	
Inner diameter of the bearing face 'da'	Diameter tolerance	
Length of the thread run-out 'x'	Dog point length	
Length of unthreaded shank 'ls'	Grip ganging length	
Outer diameter of the washer face (bearing face) 'dw'	Head blank size (Ref)	
Radius of the raised portion of a head 'rf'	Head radius	
Thickness between driving feature and bearing face 'w'	Head width	
Total depth of intendation of triple square socket 'h'	Hexagon socket size	
Wing diameter of cross recesses 'm'	Key engagement	

Tab. 5: Comparison of properties between DIN and ANSI for: “Wood screw, Cap screw and Thumb screw”

¹⁶ More details available in appendix B

¹⁷ More details available in appendix A

Most of these properties are presented in both standards DIN and ANSI. Regarding the property set of eCl@ss, it could be useful to consider and implement some of the properties based on the international standards. Furthermore the property sets of commodity classes and the description of the products should be improved by visual representations. Graphical elements are included in the standards DIN and ANSI.

2.2 Graphical Representation in Different International Standards

Graphical representations help to understand the properties related to the products. In the description of some commodities there are many technical details that are relevant. The commodity class ‘Thumb screws’ in the ANSI standard and its specific elements are supported by a visual representation. This graphic does not only include the picture illustrating the role of the attributes, but also a descriptive table of dimensions. Fig. 2 shows the complete representation of ‘Wing screw’ in the ANSI standard.

American National Standards

Wing screws ANSI-B18.17-1968,R1983

Style 1

Style 2

TYPE C

Nominal Size or Basic Screw Diameter ^a	Thds. per Inch	A		B		C		E		F		G		L	
		Wing Spread		Wing Height		Wing Thick.		Boss Dia.		Boss Dia.		Height		Practical Screw Lengths	
		Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
Type C, Style 1															
6 (0.1380)	32	0.85	0.83	0.45	0.43	0.15	0.12	...	...	0.41	0.39	0.12	0.07	0.75	0.25
8 (0.1640)	32	0.85	0.83	0.45	0.43	0.15	0.12	...	...	0.41	0.39	0.12	0.07	1.00	0.38
10 (0.1900)	24, 32	0.85	0.83	0.45	0.43	0.15	0.12	...	...	0.41	0.39	0.12	0.07	1.25	0.38
1/4 (0.2500)	20	1.08	1.05	0.56	0.53	0.17	0.14	...	...	0.46	0.44	0.12	0.07	1.50	0.50
5/16 (0.3125)	18	1.23	1.20	0.64	0.62	0.22	0.19	...	...	0.51	0.49	0.14	0.10	1.50	0.50
3/8 (0.3750)	16	1.45	1.42	0.74	0.72	0.24	0.21	...	...	0.63	0.62	0.15	0.12	1.50	0.50
Type C, Style 2															
6 (0.1380)	32	0.85	0.83	0.43	0.42	0.14	0.12	0.38	0.36	0.41	0.40	0.20	0.18	1.00	0.25
8 (0.1640)	32	0.85	0.83	0.43	0.42	0.14	0.12	0.38	0.36	0.41	0.40	0.20	0.18	1.00	0.38
10 (0.1900)	24, 32	0.85	0.83	0.43	0.42	0.14	0.12	0.38	0.36	0.41	0.40	0.20	0.18	2.00	0.38
1/4 (0.2500)	20	1.08	1.05	0.57	0.53	0.16	0.14	0.44	0.42	0.48	0.46	0.23	0.21	2.50	0.50
5/16 (0.3125)	18	1.23	1.20	0.64	0.62	0.20	0.18	0.50	0.49	0.57	0.55	0.26	0.24	3.00	0.50
3/8 (0.3750)	16	1.45	1.42	0.74	0.72	0.23	0.21	0.62	0.60	0.69	0.67	0.29	0.27	3.00	0.75
7/16 (0.4375)	14	1.89	1.86	0.91	0.90	0.29	0.28	0.75	0.73	0.83	0.82	0.38	0.37	4.00	1.00
1/2 (0.5000)	13	1.89	1.86	0.91	0.90	0.29	0.28	0.75	0.73	0.83	0.82	0.38	0.37	4.00	1.00

Fig. 2: ANSI Standard ANSI-B18.17-1968,R1983 - Wing screws¹⁸

¹⁸ Oberg, Erik; Jones, Franklin D.; Horton, Holbrook L.; Ryffel, Henry H.: Machinery's Handbook 28th Edition, "A reference book for the Mechanical engineer, Designer manufacturing engineer, Draftsman, Toolmaker and Machinist". Industrial Press Inc, (2008), pp. 1702-1705.

The same commodity class ‘Wing screw’ exists in the German standard DIN 316 with a similar graphical representation. In contrast to the ANSI American standard, the DIN representation has specific attributes for a specific wing screw ‘Rounded Wings’. It means that the ANSI American standard has the same set of attributes for different styles and types of ‘Wing screws’.

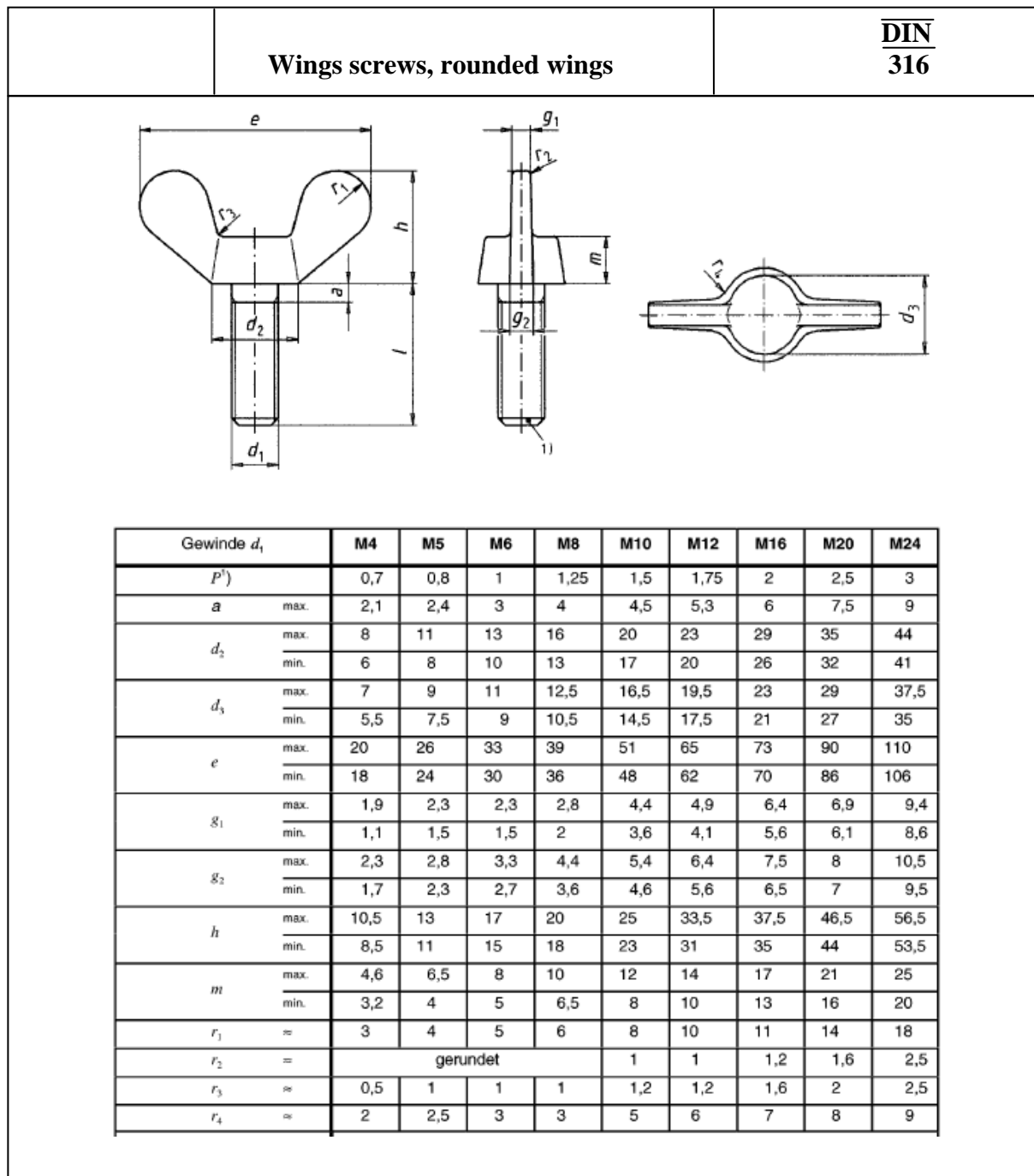


Fig. 3: DIN 316 Wings screws, rounded wings¹⁹

¹⁹ DIN 316, Wing screws, rounded wings, (July 1998). Reference Nr. DIN 316: 1998-07.

Graphical representation is a helpful instrument used by different companies which introduce their products description in electronic catalogues. Fig. 4 shows an example of the description of “Wing screw” on a German website.

NovoNox®
Inox Components

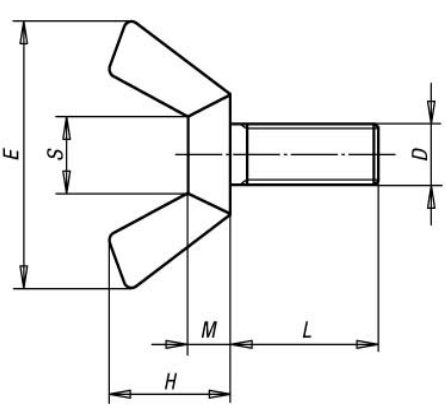
Kompetenz in Inox

Registrieren! Passwort vergessen?

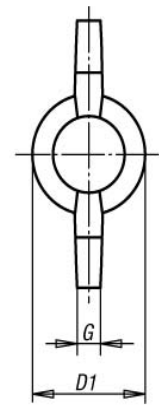

Warenkorb

Home _ Produkte _ Verbindungselemente
INHALT KONTAKT AGB IMPRESSUM

Flügelschrauben (kantig)
ähnlich DIN 316 / 318



80-16

Bestellnummer	Bestellen	D	L	D1	E	G	H	M	S	Preis	CAD
80-16-1		M4	10	8	17,6	1,6	8,6	2,9	5,2	0,70 €	
80-16-2		M4	20	8	17,6	1,6	8,6	2,9	5,2	0,81 €	
80-16-3		M4	30	8	17,6	1,6	8,6	2,9	5,2	0,85 €	
80-16-4		M4	40	8	17,6	1,6	8,6	2,9	5,2	0,89 €	
80-16-5		M5	10	10,3	22,5	2,1	11	4,1	6,7	0,77 €	
80-16-6		M5	20	10,3	22,5	2,1	11	4,1	6,7	0,82 €	
80-16-7		M5	30	10,3	22,5	2,1	11	4,1	6,7	0,90 €	
80-16-8		M5	40	10,3	22,5	2,1	11	4,1	6,7	0,97 €	
80-16-9		M5	50	10,3	22,5	2,1	11	4,1	6,7	1,67 €	
80-16-10		M6	10	12,7	27,8	2,5	13,6	5,1	8,4	0,82 €	
80-16-11		M6	20	12,7	27,8	2,5	13,6	5,1	8,4	0,89 €	
80-16-12		M6	30	12,7	27,8	2,5	13,6	5,1	8,4	0,97 €	
80-16-13		M6	40	12,7	27,8	2,5	13,6	5,1	8,4	1,10 €	
80-16-14		M6	50	12,7	27,8	2,5	13,6	5,1	8,4	1,23 €	
80-16-15		M8	20	13,8	30,3	2,8	14,8	5,6	9,1	1,45 €	
80-16-16		M8	30	13,8	30,3	2,8	14,8	5,6	9,1	1,61 €	
80-16-17		M8	40	13,8	30,3	2,8	14,8	5,6	9,1	1,74 €	
80-16-18		M8	50	13,8	30,3	2,8	14,8	5,6	9,1	1,87 €	
80-16-19		M10	20	16,5	36,2	3,3	17,7	6,8	11	2,35 €	
80-16-20		M10	30	16,5	36,2	3,3	17,7	6,8	11	2,63 €	
80-16-21		M10	40	16,5	36,2	3,3	17,7	6,8	11	2,91 €	
80-16-22		M10	50	16,5	36,2	3,3	17,7	6,8	11	3,21 €	

Fig. 4: NovoNox catalogue – wing screw according to DIN 316²⁰

Fig. 4 illustrates a complete description of the product not only with the technical drawing and the table of technical specifications based upon standards, but also presents a real picture of the product. The German company NovoNox²¹ uses the DIN standard to describe ‘Wing screw’ DIN 316²². This company offers special catalogues for stainless components and elements for engines, devices according to DIN standards. This strategy has been used successful, because it saves lengthy searches in extensive full program-catalogues and ensures a high level of technical specifications of the products.

Also other companies like Fuller (Canadian company specialised in metric fasteners and inch socket and pin products) use ISO and DIN representation schemas for the supply, import and export of products.

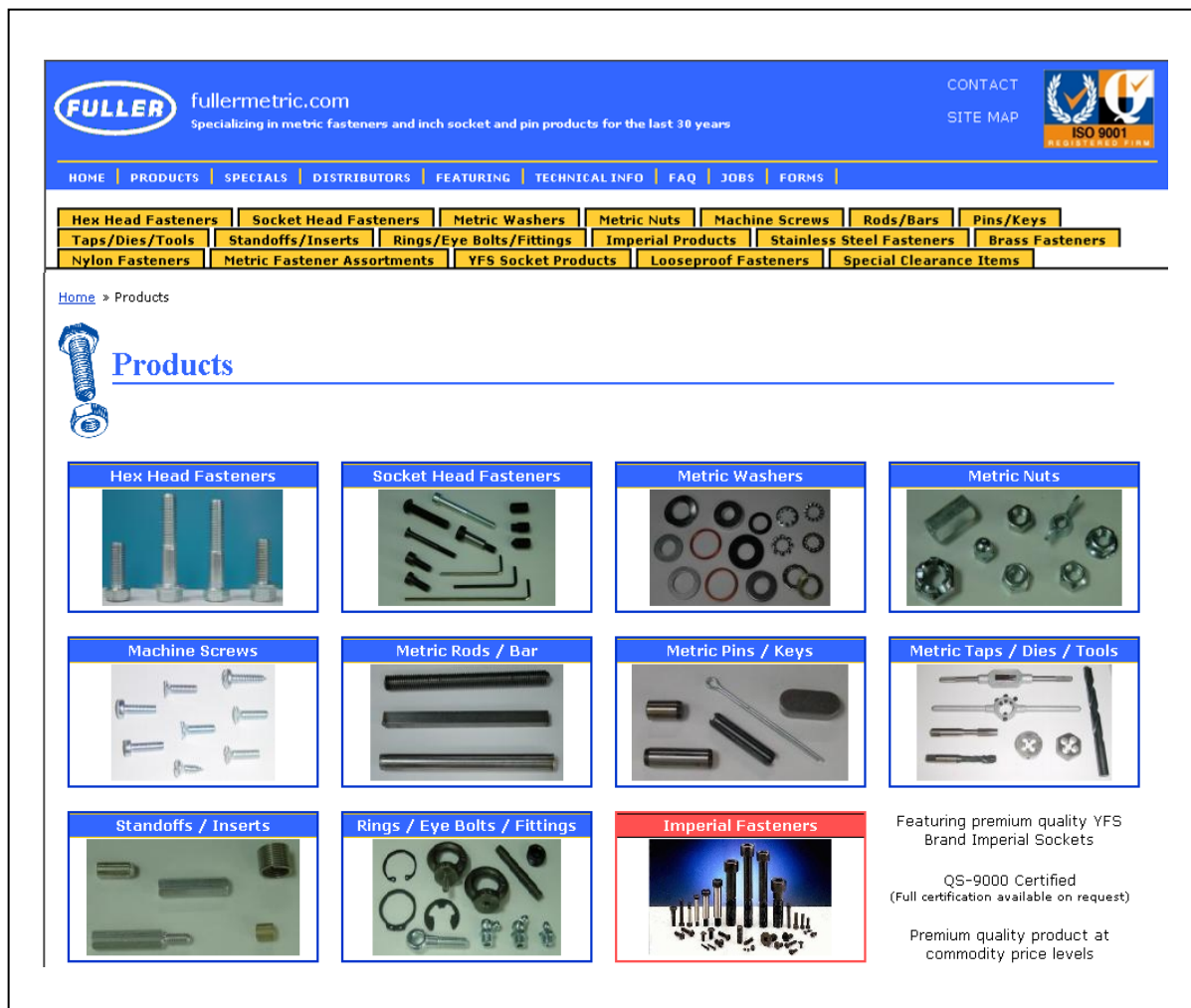


Fig. 5: Screw product catalogue according to ISO standards²³

²¹ <http://www.novonox.com>

²² DIN 316, Wing screws, rounded wings, (July 1998). Reference Nr. DIN 316: 1998-07.

²³ <http://www.fullermetric.com/sitemap.html>

2.3 Unified Language Representation - Standardised Symbols and Designations

Graphical representations are only one element that supports the description of products to visualise the technical features and dimensions. The other main element is the symbolic representation contained on these graphics. International standards like DIN, ISO and ANSI use symbols and designations to describe their graphics as we saw in chapter 2.2.

The German standard DIN contains a special part in the standard which gives specific descriptions in many languages for each symbol assigned to fasteners. This part is represented in DIN EN ISO 225 Fasteners – Bolts, screws, studs and nuts – Symbols and designations of dimensions.²⁴

DIN EN ISO 225 offers a method of dimensioning bolts, screws, studs and nuts. It includes common symbols and describes the features. In addition to terms used in the three official ISO languages (English, French and Russian) and considers the equivalent terms in other six languages. Thus DIN EN ISO 225 includes in total nine languages to describe symbols and designations of dimensions for Fasteners (bolts, screws, studs and nuts), which are:

- en: English
- fr: French
- ru: Russian
- zh: Chinese
- de: German
- it: Italian
- ja: Japanese
- es: Spanish
- sv: Swedish

Fig. 6 shows an example of a graphical representation and a table of dimensions used for DIN 96 to describe the commodity ‘Round head screw’. Tab. 6 shows the symbols and designation for such graphical representation extracted from the DIN EN ISO 225.

²⁴ DIN EN ISO 225, Fasteners – Bolts, screws, studs and nuts – Symbols and designations of dimensions (ISO/DIS 225:2009), (March 2009). Ref. Nr. EN ISO 255:2009 (D).

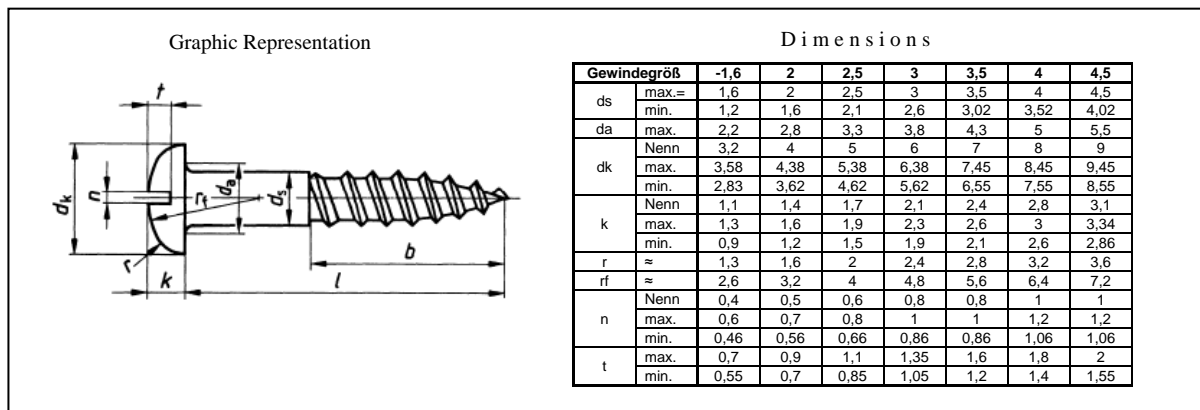


Fig. 6: DIN 96 Round head wood screw

Symbol	Designation	Symbol	Designation
dk	en: diameter of the head	da	en: inner diameter of the bearing face
	fr: diamètre extérieur de tête		fr: diamètre intérieur de la face d'appui
	ru: диаметр головки		ru: внутренний диаметр опорной поверхности
	zh: 头部直径		zh: 过渡圆直径
	de: Kopfdurchmesser		de: Innendurchmesser der Auflagefläche
	it: diametro della testa		it: diametro interno della faccia di appoggio sotto
	ja: 頭部の径		ja: 丸み移行円の径
n	es: diámetro de la cabeza	ds	es: diámetro de transición
	sv: huvudets diameter		sv: innerdiameter på anliggningsplan
	en: width of the slot		en: diameter of the unthreaded shank
	fr: largeur de fente		fr: diamètre de la partie lisse (diamètre de tige)
	ru: ширина шлица		ru: диаметр гладкой части (стержня)
	zh: 开槽宽度		zh: 无螺纹杆径
	de: Schlitzbreite		de: Schaftdurchmesser
r	it: larghezza dell'intaglio	t	it: diametro del gambo
	ja: すりわりの幅		ja: 円筒部の径
	es: anchura de la ranura		es: diámetro de la cana
	sv: spårbredd		sv: stamdiameter
	en: radius of curvature under head		en: depth of the internal driving feature or slot
	fr: rayon sous tête		fr: profondeur de l'empreinte ou de la fente
	ru: радиус под головкой	l	ru: глубина внутреннего привода
k	zh: 头下圆角半径		zh: 扳拧部分的深度或开槽深度
	de: Übergangsradius unter dem Schraubenkopf		de: Eindringtiefe des Innenantriebes
	it: raggio di raccordo sotto testa		it: profondità delle superficie di manovra
	ja: 首下丸み部の半径		ja: 内側駆動形体の深さ
	es: radio de acuerdo		es: profundidad del hueco o ranura
	sv: radie för övergång mellan stam och anliggningsplan		sv: greppdjup hos invändigt grepp eller spår
	en: height of the head	b	en: nominal length
rf	fr: hauteur de tête		fr: longueur nominale
	ru: высота головки		ru: номинальная длина
	zh: 头部高度		zh: 公称长度
	de: Kopfhöhe		de: Nennlänge
	it: altezza della testa		it: lunghezza nominale
	ja: 頭部の高さ		ja: 呼び長さ
	es: altura de la cabeza		es: longitud nominal
rf	sv: huvudhöjd		sv: nominell längd
	en: radius of the raised portion of a head	b	en: thread length
	fr: rayon du bombé de la tête		fr: longueur filetée
	ru: радиус сферы головки		ru: длина резьбы
	zh: 头部球面半径		zh: 螺纹长度
	de: Wölbungsradius des Linsenkopfes		de: Gewindelänge
	it: raggio di curvatura della calotta		it: lunghezza filettata
	ja: 頭部丸み部の半径		ja: ねじ部長さ
rf	es: radio de abombado		es: longitud roscada
	sv: krökningsradie på rundat huvud eller kullerhuvud		sv: gänglängd

Tab. 6: Extraction of Symbols and designations for screws²⁵ applied to 'DIN 96-Round head wood screw'

²⁵ DIN EN ISO 225, Fasteners – Bolts, screws, studs and nuts – Symbols and designations of dimensions (ISO/DIS 225:2009), (March 2009). Ref. Nr. EN ISO 255:2009 (D)

The designation of symbols described in many languages is useful to unify a common understanding of the product and to reduce language problems like wrong translations. That helps to define well developed property sets based upon standardised schemas. Thus we can propose to improve the eCl@ss classification system by graphical representations used in the international standards and unify languages in the set of properties applying standard designations like DIN EN ISO 225 for the graphical representations.

3. Graphical Elements for Elementary Composite Commodities

In the chapter 2 we focused on very elementary products like screws and we saw how a simple product can be described by standards which support the description by graphical representations of the product. In contrast to these elementary commodities, composite products like water taps, shower system installations etc. have different descriptions according to the producer's perspective. In this case graphical representations for products of such commodity classes are derived from graphical representations in web catalogues. In this chapter we analyse commodity classes related to 'Shower' in the eCI@ss classification system and compare it with descriptions of a producer like "Grohe" and a distributor like "Home depot".

Analysing the eClass classification system we can observe that it contains not well developed elementary composite commodities like e.g. the commodity group "Shower" as is illustrated in Tab. 7.

eCI@ss			
Segment	No.	Code name	Preferred Name
Construction technology	1	22-36-14-01	Shower cubicle
	2	22-36-15-01	Shower unit
	3	22-36-15-90	Shower system (sanitary, unclassified)
	4	22-36-15-91	Shower system (sanitary, parts)
	5	22-36-15-92	Shower system (sanitary, accessories)
	6	22-36-14-02	Shower curtain
	7	22-36-14-90	Shower partition (sanitary, unclassified)
	8	22-36-16-90	Hand-shower set (sanitary, unclassified)
	9	22-36-16-91	Hand-shower set (sanitary, parts)
	10	22-36-16-92	Hand-shower set (sanitary, accessories)

No.	Property set
1	BAA271003 - EAN code
2	BAA001003 - Manufacturer name
3	BAD847002 - Manufacturer product number
4	BAA316003 - Product name
5	BAA002002 - Product type description
6	BAA059003 - Supplier product number

Tab. 7: Properties of 'Shower set' – eCI@ss ²⁶

²⁶ www.eclass.com / www.eclass.de

In the table above we see that 10 commodity classes are described only by 6 properties. Surprisingly eCl@ss has gaps in such set of properties, considering that 5 of them are 'basic' and are not enough to describe the commodity "Shower".

Technical standard specifications are important to provide necessary details about the product. In e-commerce it is important for the producers to include in their electronic catalogues an appropriate description of the product. One example is the Germany Company “Grohe”²⁷, which produces fittings and sanitary systems. From the website of “Grohe” we extracted some products in order to collect the technical specification from different types of showers as shown in Tab. 8.

Product Name	Hand Shower system	Shower System	Massage shower set	Shower set	Trio Hand Shower system	Hand shower 5
Product Number	28617	28574	27243	27140	28435	27142
Product line	Relaxa	Movario	Euphoria	Rain shower Rustic	Tempesta	Relaxa Rustic
Shower bar Height	620mm (24 3/8 In)	500-900mm	620mm (24 In)	620 mm (24 7/16 In)	620 mm (24 3/8 In)	620 mm
Hose Length	59 In	59 In	59 In	59 In	59 In	59 In
Diameter of the bar	28 mm					
Diameter of the hose	G1/2	G1/2	G1/2	G1/2	G1/2	G1/2
Code Compliance	ASME/ANSI A112. 18. 1M, ADA compliant	ASME/ANSI A112. 18. 1M	ASME/ANSI A112. 18. 1M	ASME/ANSI A112. 18. 1M	ASME/ANSI A112. 18. 1M, ADA compliant	ASME/ANSI A112. 18. 1M
Color Options	Chrome	Infinity satin nickel, Chrome, infinity polished brass, Infinity Brushed nickel	Starlight Chrome	Starlight Chrome, Sterling infinity Finish, Infinity Brushed nickel, Oil Rubbed Bronze	Starlight Chrome, Infinity Brushed nickel	Starlight Chrome, Sterling infinity Finish, Infinity Brushed nickel, Oil Rubbed Bronze
Flow rate	2.5 GPM at 80 psi (9.5 lpm)	2.5 GPM at 80 psi (9.5 lpm)	2.5 GPM at 80 psi (9.5 lpm)	N/A	2.5 GPM at 80 psi (9.5 lpm)	2.5 GPM at 80 psi (9.5 lpm)

Tab. 8: Properties of ‘Shower system’ – Grohe Catalogue²⁸

Tab. 8 shows some details concerning a list of six shower systems produced by “Grohe”. On the one hand we can observe that “Grohe” and eCl@ss have some similar basic specifications like e.g. product name, product number and product line, on the other hand “Grohe” contains detailed technical descriptions like e.g. the height of the shower bar, length of the shower hose, diameter of the hose, color options, etc. Furthermore “Grohe” developed their product descriptions based on the American standard ASME/ANSI.

²⁷ http://www.groheamerica.com/p/25_7676.html

²⁸ http://www.groheamerica.com/p/25_7676.html

Additionally the list of specifications of “Grohe” is complemented by a description of the products with a graphical representation. Fig. 7 and Fig. 8 illustrate the detailed graphical description for 'RELEXA Hand shower system' extracted from “Grohe Catalogue”.

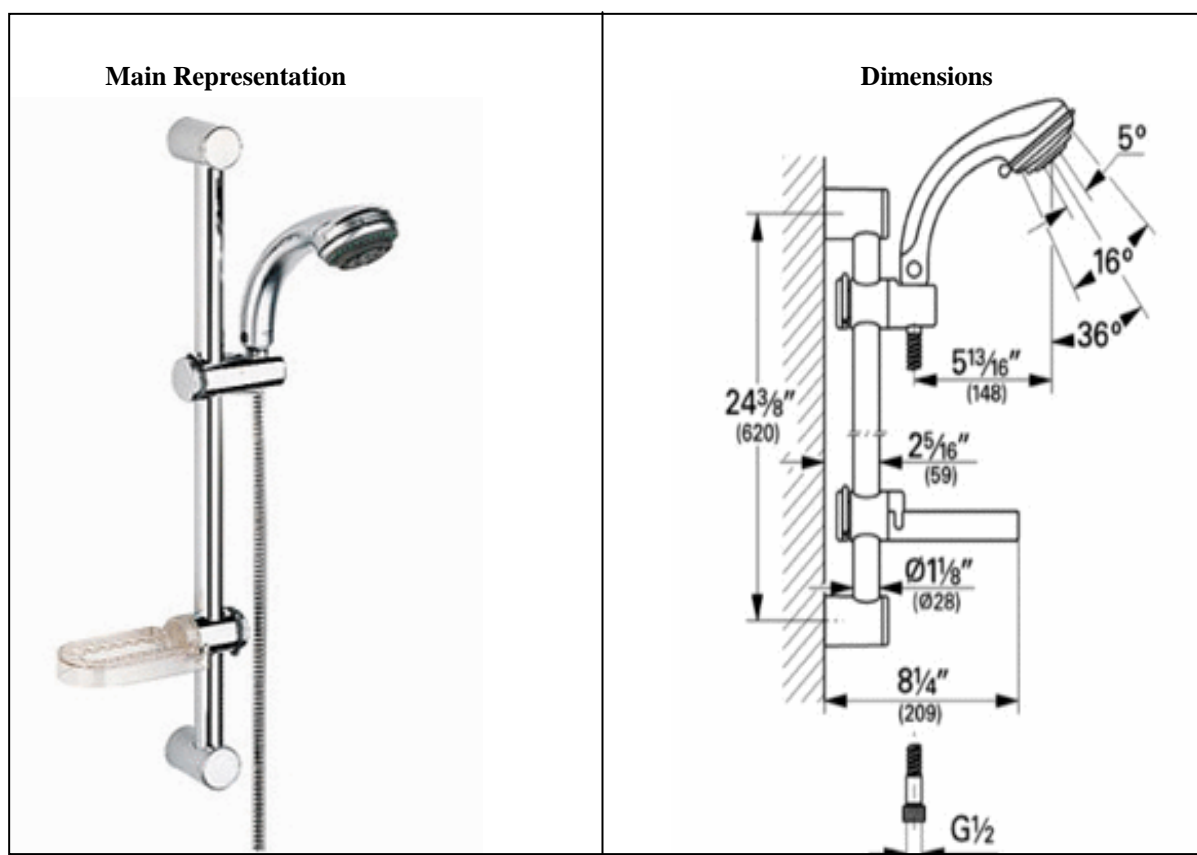
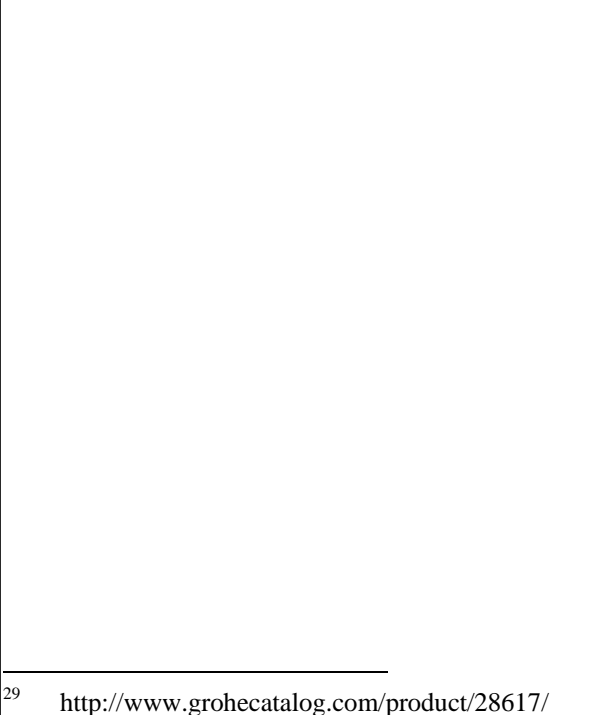
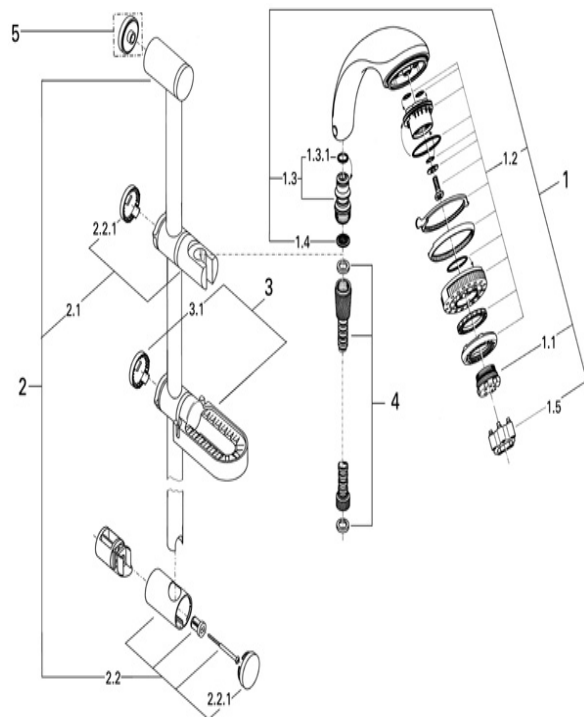


Fig. 7: Technical representation and real picture of ‘RELEXA Hand shower system’ – Grohe catalogue ²⁹

Exploded picture	Parts list			
	Pos	Spare Part	Product	Pcs.
		RELEXA Top 4 hand shower system 28 617		
	1	Top 4 hand shower	28 179	1
	1.1	Pulsator element	45 656	1
	1.2	Rose kit	45 660	1
	1.3	Male coupling piece	28 637	1
	1.3.1	O-ring	01 224	1
	1.4	Filter screen	07 002	1
	1.5	Relaxa plus tool	45 654	1
	2	Shower bar	28 620	1
	2.1	Hand shower holder	45 650	1
	2.2	End bracket	45 651	1
	2.2.1	Wall bar cap	45 652	1
	3	Scap dish	28 631	1
	3.1	Wall bar cap	45 652	1
	4	59" metal hose	28 105	1
²⁹ http://www.grohecatalog.com/product/28617/				



	Special Accessories		
5	Wall bar spacer	45 459	1

Fig. 8: Exploded picture and Part list of ‘RELEXA Hand shower system’ – Grohe catalogue³⁰

Fig. 7 illustrates a real picture of the product and the technical picture which describes the dimensions of the shower system. Thus, from the general approach to the specific details, “Grohe” shows in the exploded picture (Fig. 8) and provides a list of parts that contains the shower.

In contrast to “Grohe” (producer), it would be interesting to compare the description for the same commodity 'Shower' from the perspective of a distributor like “Home Depot”. Tab. 9 shows the description of 6 showers from different brands.

Product name	Master shower Hotel Hand shower kit	3 function hand shower	Slide bar kit with shower head and soap holder	Drill-Less slide bar Combo	Wall bar with 5 –spray /massage Hand shower	Single complete shower system kit
Brand Name	Kohler	Delta	Latoscana	Price Pfister	Alsons	American Standard
Manufacturer	Kohler	Delta faucet company	Paini SPA RUBINETTE RIF	Price Pfister	Alsons Corporation	American Standard
Collection Name	Master shower	Contemporary	Latoscana	16 series	Premium shower series	One
Color/Finish	Polished chrome, Bronze	Chrome	Chrome	Chrome	Rustic Bronze	Polished Chrome
Energy Compliant	No	No	No	No	No	No

³⁰ <http://www.grohecatalog.com/product/28617/>

Faucet Flow rate	2.5 GPM	2.5 GPM	2.5 GPM	2.5 GPM	2.5 GPM	2.5 GPM
Width	10.25 In		0.60 In	4.75 In	12 In	0.50 In
Assembled depth (in Inches)	24.88 In	4.00 In	6 In	5 In	37.5 In	3 In
Assembled Height (in Inches)	3.63 In	30 In	31.7 In	28 In	4.25 In	24 In
Assembled Weight (in LBS)	4.5	3.9	10	3.95	2.15	7.3000
Assembled width (in Inches)	10.25 In	2.00 In	9.25 In	4 In	2.5 In	3.00 In
Faucet connection size	1-1/2 in n.p.s	1/2 "	1/2 " NPT female	1/2 "		

Tab. 9: Properties derived from Home depot Catalogue³¹

We can see in the table above that distributors like “Home Depot” include technical information like e.g. width, faucet flow rate, assembled depth, assembled height and weight. But in contrast to “Grohe”, “Home Depot” presents general information but does not focus on graphical representations. “Home Depot” developed its catalogue to help the client to compare the products from different brands according to the design, price and simple technical information. This comparison is extended with an open network where the client can add a comment about the quality of the product. This approach helps to facilitate the clients decision by means of experience of others but not by the deeper information about the product.

Graphical representations can be useful for the description of elementary composite commodities. One proposal to develop a useful set of attributes that contribute to the description of properties in eCl@ss is the implementation of graphical representations. Graphical representations describe not only the main properties but also give a visual representation of the product which can be helpful in a B2B or B2C relationship.

³¹ www.homedepot.com/webapp/wcs/stores/servlet/Navigation?N=10000003+90401+500736&langId=-1&storeId=10051&catalogId=10053&Ntk=AllProps

4. Graphical Elements for Complex Commodities

A complex commodity class is a collection of many elementary composite commodities which take part of the structure of a final product, like for e.g. computers, printers, cars, trailers, motorbikes, bikes, etc. The bicycle is a good example of a complex commodity,

The bicycle contains main parts like the frame, handlebars, pedal, breaks, gears, chain, saddle, wheels, etc., and each of these main parts contains other elementary components. Thus a bicycle is made up of more than 30 parts. Fig. 9 shows a visual representation of many parts of a bicycle and its technical names.

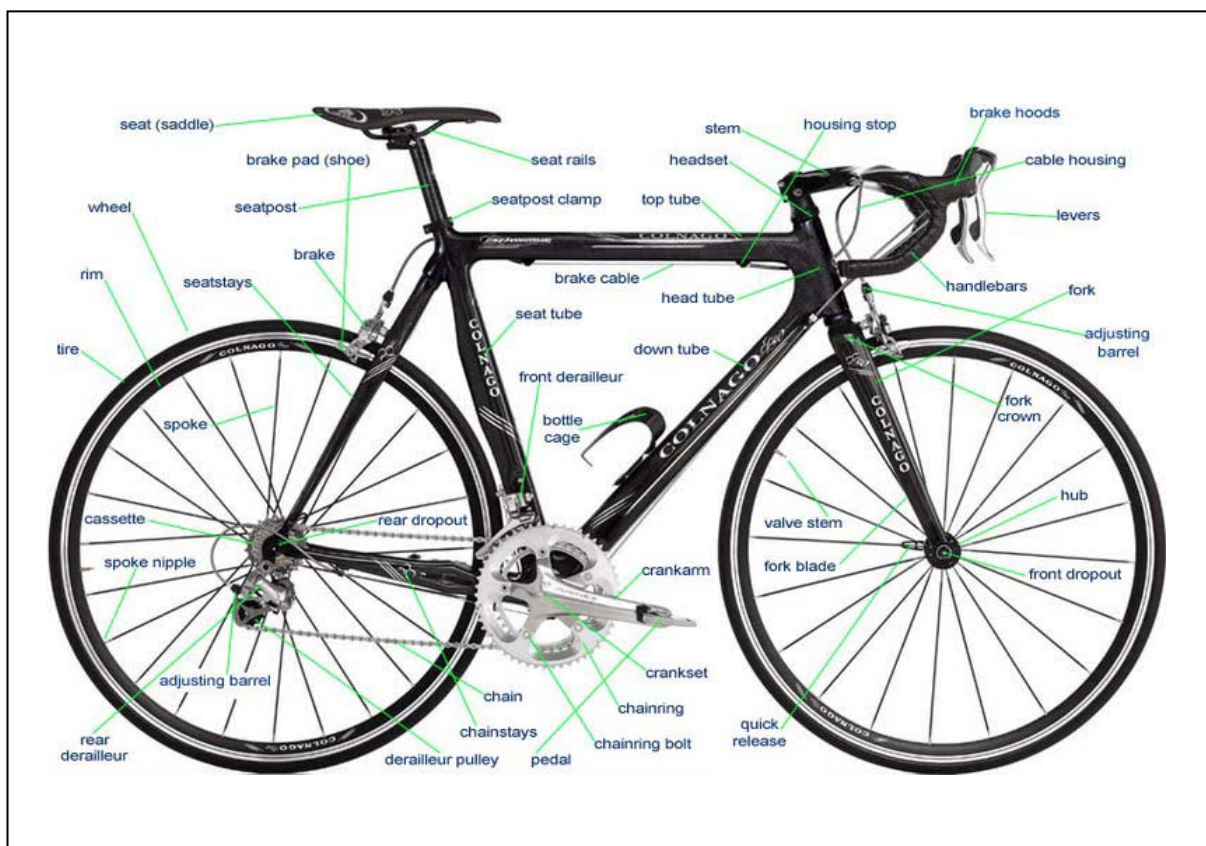


Fig. 9: Different parts of a bicycle – A visual representation³²

For such complex commodities the information in web catalogues begins with a graphical representation like the figure above, the description of features, specification of dimensions and the technical specifications as are shown in Tab. 10 and Tab. 11.

³² <http://linuxandfriends.com/2008/11/23/different-parts-of-a-bicycle-a-visual-representation/>

DIMENSIONS					
Size	44	48	51	54	56
Seat-Tube Length, B-B Center to Top	400mm	430mm	450mm	480mm	500mm
Top-Tube Length, Horizontal	496mm	506mm	518mm	537mm	548mm
B-B Drop	73mm	73mm	73mm	73mm	71.5mm
Chain-Stay Length	405mm	405mm	405mm	405mm	408mm
Seat-Tube Angle	76°	75.75°	75.5°	74°	73.5°
Head-Tube Angle	70.5°	71.25°	72°	72°	72°
Fork Rake	51mm	51mm	49mm	49mm	49mm
Trail	66mm	62mm	59mm	59mm	59mm
Front-Center	574mm	579mm	582mm	588mm	595mm
Wheelbase	967mm	973mm	976mm	982mm	993mm
Stand-Over Height	693mm	718mm	735mm	758mm	778mm
Head-Tube Length	105mm	115mm	125mm	145mm	165mm
Handle-Bar Width	380mm	380mm	400mm	400mm	420mm
Stem Length	75mm	75mm	90mm	100mm	100mm
Crank Length	165mm	165mm	170mm	170mm	172.5mm
Seat-Post Length	300mm	300mm	350mm	350mm	350mm

TT is measured horizontally from center of HT to center of ST
 *Not all sizes available in all markets.

Tab. 10: Dimensions of bicycle Rubi Pro Dura-Ace – ‘Specialized-bike’³³ catalogue

TECHNICAL SPECIFICATIONS	
MODEL	Rubi Pro Dura-Ace
FRAME	Specialized FACT 8r carbon, Az1 construction, Designs for Women compact design, Zertz
REAR SHOCK	N/A
FORK	Specialized FACT carbon, monocoque construction, full carbon legs, crown and steerer w/ Zertz
HEADSET	Specialized Campy Style, 1-1/8" integrated threadless, sealed stainless steel cartridge bearings, 20mm carbon cone w/ one 10mm and two 5mm carbon spacers
STEM	Specialized Pro-Set, 3D forged alloy, 4-bolt 31.8mm bar clamp, 4- position adjustable
HANDLEBARS	Specialized Ruby SL, FACT carbon Women's handlebar, short-reach drop, ergonomic shaping, 31.8mm
TAPE	Body Geometry Bar Phat, cork ribbon w/ 2.5mm gel padding
FRONT BRAKE	Shimano Ultegra SL
REAR BRAKE	Shimano Ultegra SL
BRAKE LEVERS	New Shimano Dura-Ace, 10-speed STI, flight deck compatible
FRONT DERAILLEUR	Shimano Ultegra SL, 34.9mm clamp, bottom pull
REAR DERAILLEUR	New Shimano Dura-Ace
SHIFT LEVERS	New Shimano Dura-Ace, 10-speed STI, flight deck compatible
CASSETTE	Shimano Ultegra, 10-speed, 12-27t
CHAIN	Shimano Dura-Ace, 10-speed
CRANKSET	Specialized FACT Pro carbon, integrated oversize design
CHAINRINGS	50 x 34t
BOTTOM BRACKET	Specialized oversize integrated
PEDALS	Silver cage, black body, w/ toe clip and strap
RIMS	Roval Roubaix SL, E5 alloy, machined sidewalls
FRONT HUB	Roval Roubaix SL, carbon center tube w/ alloy flanges, 24h
REAR HUB	Roval Roubaix SL, CNC alloy body Swiss-made internals, ratchet and cassette body, 30 hole
SPOKES	DT Aerolite butted
FRONT TIRE	Specialized All Condition Pro, 700x23c, aramid bead, 120TPI w/ Flak Jacket
REAR TIRE	Specialized All Condition Pro, 700x23c, aramid bead, 120TPI w/ Flak Jacket
INNER TUBES	Specialized standard presta tube
SADDLE	Body Geometry Ruby Women's, carbon reinforced base, hollow Ti rails, microfiber cover
SEATPOST	Specialized Pro SL, FACT carbon w/ Zertz insert, 27.2mm
SEAT BINDER	Specialized CNC alloy, 32.6mm
NOTES	Carbon chain stay protector, derailleur hanger, clear coat, owners manual

Tab. 11: Technical specifications of bicycle Rubi Pro Dura-Ace – ‘Specialized-bike’³⁴ catalogue

³³ <http://www.specialized.com/us/en/bc/home.jsp>

³⁴ <http://www.specialized.com/us/en/bc/home.jsp>

In contrast to the web catalogues, the eCl@ss classification system describes a bike by 5 basic properties and does not contain more specific properties as is illustrated in the table below.

eCl@ss 28-07-02-90 Bike (unclassified)
Property-Set:
BAA001003 - Manufacturer name
BAD847002 - Manufacturer product number
BAA316003 - Product name
BAA002002 - Product type description
BAA059003 - Supplier product number

Tab. 12: Bike property set – eCl@ss classification system

Graphical representations of complex objects are useful to describe the main components and detail the description of the elementary commodities. In the same direction classification systems like eCl@ss should improve the set of properties of complex commodity classes getting a good structure for the description of such products like bikes.

Graphical representations are used for engineers, designers and architects in order to support the description of elements. Fig. 10 shows a technical illustration presented on a website. In this case the screen shot presents the exploded technical illustration of a bicycle project³⁵, but we can find other illustrations related to different sectors (medical, automotive, architectural, etc.) in the same webpage.

³⁵ More details available in appendix D

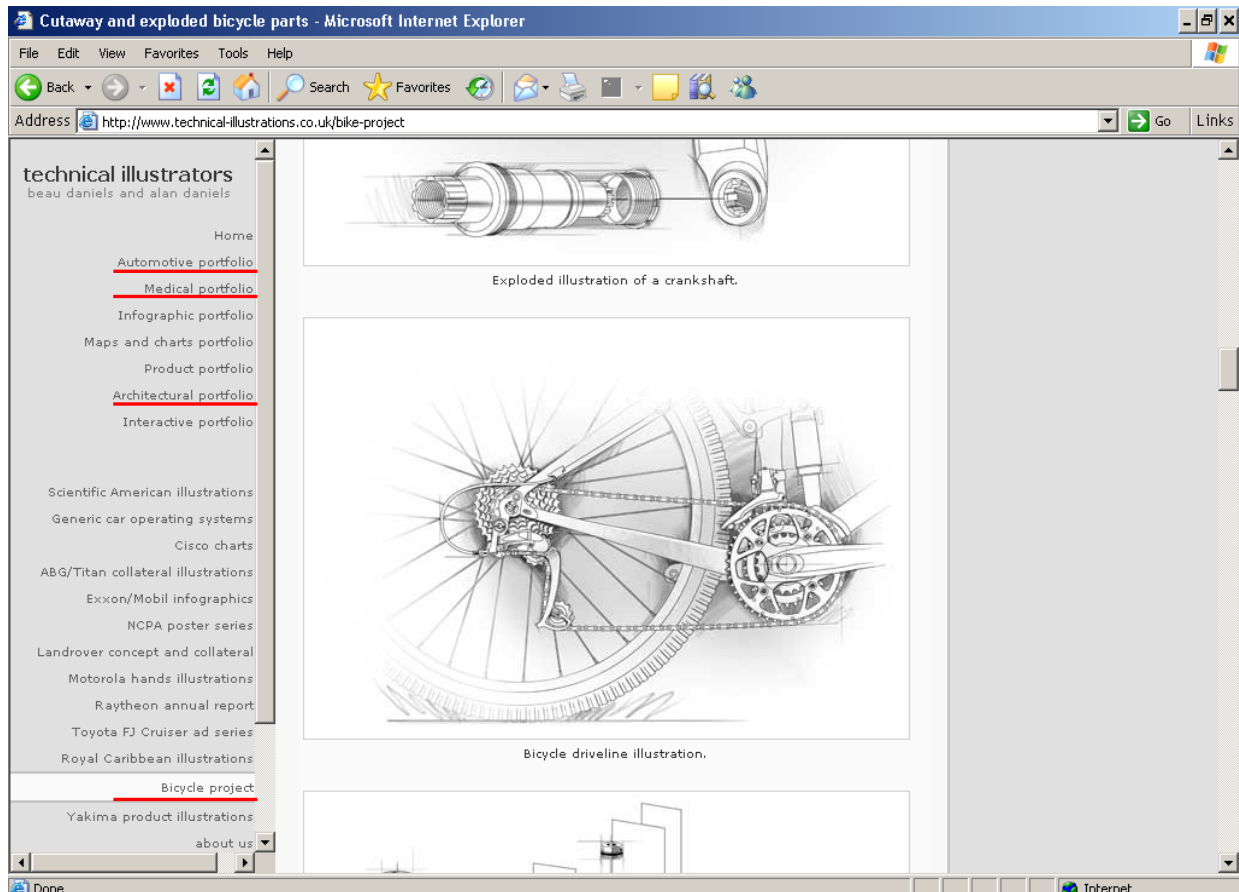


Fig. 10: Exploded Technical Illustration of various bicycle parts³⁶

“The need for technical illustrations and technical illustrators is increasing due to various factors, including stricter European Union regulations and warranty issues demanding higher quality documentation.”³⁷ Exploded illustrations are part of the methods used for stylistic devices. Other methods are cutaway drawings and ghost representations.³⁸

³⁶ <http://www.technical-illustrations.co.uk/bike-project.html>

³⁷ Giemsa, Betina. "Technical illustration in the 21st century: A primer for today's professionals", (2007). PTC.com. in white paper

³⁸ Giemsa, Betina. "Technical illustration in the 21st century: A primer for today's professionals", (2007). PTC.com. in white paper. pp 3.

5. Conclusion

The eCl@ss classification system describes the commodity classes based upon properties sets, but sometimes those properties are not enough to describe the commodity and even essential properties are missing like for example 'length' or 'thread length' for the commodity 'screw'.

In contrast to eCl@ss, international standards like ANSI, DIN and ISO describe the commodities with a complete set of properties based on graphical elements described by *standardised symbols*. In the German standard DIN, each symbol is a designation of a property and for each symbol there exist a designation in different languages. It means that DIN standard created a common symbolic language.

Web catalogues use graphical representations to describe the products based on standards like DIN and ISO. In the same way eCl@ss classification system can support the description of commodities including graphical representations acquired from international standards for all types of commodities (Elementary non-composite, composite and complex commodities), in order to visualise the product to have a better description of the elements, dimensions and features.

The introduction of graphical elements can contribute to develop not only the description of commodity classes in the eCl@ss classification system but also to harmonise and unify their various language versions.

Appendix A

ANSI – List of technical properties for: Wood screws, Wing screws and Cap screws

No.	Property Set	Wood screws			Wing nut, wing screws and thumb screws			Cap screws
		Flat Head	Oval Head	Pan Head	Wing screws Type A and B	Wing screws Type C and D	Thumb screws Type A and B	Hexagon socket head cap screws-Metric series
		ANSI-B18.6.1-1981(R2003)			ANSI-B18.17-1968(R1983)			BS4168:Part1:1981(obsol.)
1	Body diameter							x
2	Body length							x
3	Boss diameter				x		x	
4	Boss height				x			
5	cone point				x	x	x	
6	Cup and flat point diameter				x	x	x	
7	Depth of slot	x	x	x				
8	Diameter fillet							x
9	Diameter of thread	x	x	x	x	x	x	x
10	Diameter tolerance	x	x	x				
11	Dog point diameter				x	x	x	
12	Dog point length				x	x	x	
13	Grip ganging length							x
14	Head blank size (Ref)				x			
15	Head diameter	x	x	x				x
16	Head radius			x				
17	Head thickness					x		
18	Head width					x		
19	Height of head	x	x	x		x		x
20	Hexagon socket size							x
21	Key engagement							x
22	Length of thread	x	x	x				
23	Major diameter of screw	x	x	x	x	x	x	x
24	Material				x	x	x	
25	Nominal size or basic screw diameter				x	x	x	x
26	Oval point radius				x	x	x	
27	Practical screw length				x	x	x	
28	Radius or fillet							x
29	Screw Height	x	x	x	x	x	x	x
30	Screw length	x	x	x				
31	Series (heavy, light and regular)				x	x		
32	Series (regular and heavy)					x		
33	Shank permanently inserted into wing portion				x		x	
34	Shank welded to wing portion						x	
35	Shoulder diameter					x		
36	Style				x		x	
37	Threads per inch				x	x	x	
38	Total head height		x					
39	Transition thread length							
40	Wall Thickness							x
41	Width across corners							x
42	Width across flats							x
43	Width of slot	x		x				
44	Wing height				x		x	
45	Wing spread				x		x	
46	Wing thickness				x		x	

[illegible]

Appendix B

DIN – List of technical properties for: Wood screws, Wing screws and Cap screws

DIN Property sets		Wing screws	Wood screws				Cap screws
		Rounded wings	Slotted raised countersunk (oval) head wood screws	Slotted round head wood screws	Slotted countersunk (flat) head wood screws	Hexagon head wood screw	Hexagon socket head cap screws
		DIN 316	DIN 95	DIN 96	DIN 97	DIN 571	DIN EN ISO 4762
1	Basic major diameter (nominal diameter) of thread 'd'						x
2	Boss diameter of head	x					
3	Boss diameter of length	x					
4	Depth of the internal driving feature or slot 't'		x	x	x		x
5	Diameter of shank	x					
6	Diameter of the head 'dk'		x	x	x		x
7	Diameter of the unthreaded shank 'ds'		x	x	x	x	x
8	Distance from the last full form thread, shank length of bolt 'lg'						x
9	Distance from the last full form thread to the bearing face 'a'	x	x		x	x	
10	Dog point diameter	x					
11	Head thickness	x					
12	Height of the head 'k'		x	x	x	x	x
13	Height of the raised (oval) portion of a raised countersunk head 'f'		x				
14	Incomplete thread end 'u'						x
15	Inner diameter of the bearing face 'da'			x		x	x
16	Length of the thread run-out 'x'						x
17	Length of unthreaded shank 'ls'						x
18	Nominal length 'l'	x	x	x	x	x	x
19	Outer diameter of the washer face (bearing face) 'dw'						x
20	Oval point Radius	x					
21	Radius of curvature under head 'r'			x			x
22	Radius of the raised portion of a head 'rf'		x	x			
23	Shank permanently inserted into wing portion	x					
24	Shank welded to wing portion	x					
25	Thickness between driving feature and bearing face 'w'						x
26	Thread length 'b'		x	x	x	x	x
27	Total depth of indentation of triple square socket 'h'	x					
28	Transition length 'lf'						x
29	Width across corners 'e'	x				x	x
30	Width across flats 's'					x	x
31	Width of the slot 'n'		x	x	x		
32	Wing diameter of cross recesses 'm'	x					
33	Wing thickness	x					

Appendix C

International Standards

DIN - *Deutsches Institut für Normung (German Institute for Standards)*

The vast majority of metric fasteners are presently manufactured to this standard which was created long before ISO standards. There are DIN standards for just about everything. DIN standards are currently being revised to more closely match ISO standards. For ordering fasteners all you need is:

1. The DIN(which defines the style of the fastener)
2. The material desired (i.e. 8.8 Steel, 316 Stainless, Hastelloy C276)
3. The coating or plating (if any)

ISO - *International Standard Organization*

Founded in 1946 this organization publishes standards which individual countries have to vote on and are asked to apply. Currently ISO is comprised of more than 90 member countries. ISO's standards for metric fasteners are rapidly gaining more recognition and in the years to come will probably become the world standard.

ANSI - *American National Standard Institute*

ANSI is an American organization that has developed standards which are essentially in agreement with ISO standards.

JIS - *Japanese Industrial Standard*

Although mainly based on DIN some standards have been modified based on the needs of the Japanese market. Fasteners used in most electronic equipment manufactured in Japan fall under the JIS standard.

All of the standards listed above detail an items' dimensional specifications and material content. These standards are accepted worldwide and ensure you that any items that are ordered according to a particular standard will meet the specifications in compliance to the listed standards regardless of the manufacturer. Although there are many different standards for metric they are all manufactured to the same thread. The DIN spec may call for a certain head dimension and ANSI spec another but a 10x1.25 ANSI hex bolt will always thread into a DIN 10x1.25 hex nut and vice versa.³⁹

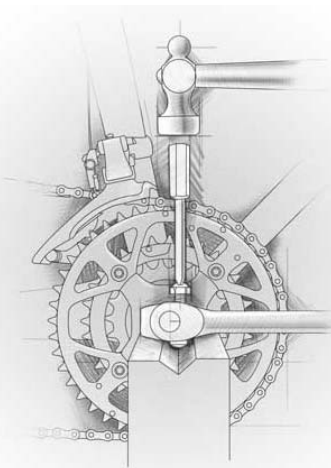
³⁹ <http://fullermetric.com/faq>

Appendix D

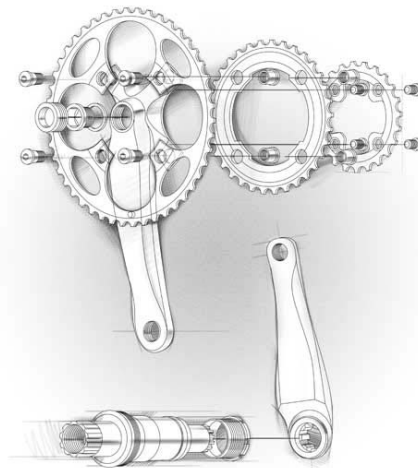
Extraction of some exploded illustration for bicycle project



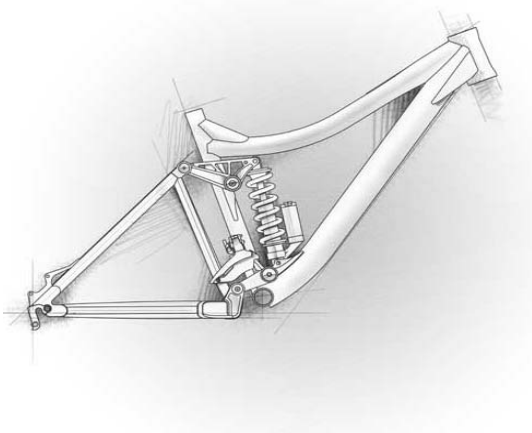
Exploded style illustration of 10 speed gears.



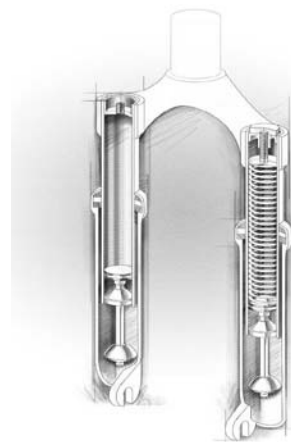
Cotter pin removal illustration.



Exploded illustration of a crankshaft.



Sprung frame illustration.



Cutaway illustration of front suspension forks.

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